DOCUMENTATION OF BUILDING 1815 U.S. ARMY FIELD ARTILLERY CENTER FORT SILL MILITARY RESERVATION, OKLAHOMA

by

Joe C. Freeman, AIA
Kellie A. Krapf

for

Environmental Division, Directorate of Public Works
Fort Sill Military Reservation
Fort Sill, Oklahoma
and
U.S. Army Corps of Engineers
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The documentation of Building 1815 located at the US Army Field Artillery Center and Fort Sill, Oklahoma, was conducted to mitigate the demolition of the building. Architectural documentation of this 1911 power and ice plant building included interviews, archival research, and photographs. A historic context of early power and ice plants was also prepared.

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U.S. ARMY FIELD ARTILLERY CENTER
FORT SILL MILITARY RESERVATION, OKLAHOMA

by

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ENVIRONMENTAL DIVISION, DIRECTORATE OF PUBLIC WORKS
FORT SILL MILITARY RESERVATION
FORT SILL, OKLAHOMA

and

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

FORT SILL MILITARY RESERVATION TECHNICAL SERIES
REPORT OF INVESTIGATIONS NUMBER 6

Geo-Marine, Inc.
550 East Fifteenth Street
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ABSTRACT

The documentation of Building 1815 located at the U.S. Army Field Artillery Center, Fort Sill Military Reservation, Oklahoma was conducted to mitigate the demolition of the building. Geo-Marine, Inc. conducted this work under Contract No. DACW-56-92-D-0010, Delivery Order No. 0018, between December 1993 and May 1994. Duane E. Peter, Director of the Cultural Resources Management Division of Geo-Marine, Inc., served as Principal Investigator. The architectural fieldwork was done by Joe C. Freeman, AIA. Architectural documentation included review of materials in the Fort Sill archives, an interview with Towana Spivey, Director of the Fort Sill Museum and Archives, field investigation and notes, and photography. The photography included 35 mm color slides, 35 mm black-and-white, and large format, 4-x-5 black-and-white. An historic context was prepared by Kellie A. Krapf, archeologist and historian. The historical research includes archival research and personal communications with Pamela Schenian of Fort Knox, Kentucky.

BUILDING 1815
POWER AND ICE PLANT
U. S. ARMY FIELD ARTILLERY CENTER AND FORT SILL
FORT SILL
COMANCHE COUNTY
OKLAHOMA

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA
REDUCED COPIES OF ORIGINAL DRAWINGS

Historic American Buildings Survey
National Park Service
Rocky Mountain Regional Office
Department of the Interior
P. O. Box 25287
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HISTORIC AMERICAN BUILDINGS SURVEY

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Joe C. Freeman, Photographer, November 1993

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NO. 3 PARTIAL VIEW OF WEST SIDE, LOOKING BAST
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HISTORIC AMERICAN BUILDINGS SURVEY

BUILDING 1815
POWER AND ICE PLANT

Location: Building 1815, Power and Ice Plant, is located at the southwest corner of Fort Sill Road and Macomb Road adjacent to the railroad track.

Date of Construction: Building 1815 was completed on November 28, 1911 from drawing completed in 1909. Substantial renovations have occurred since the building's construction.

Present Owner: U.S. Army

Present Use: Vacant

Significance: Building 1815, Power and Ice Plant, derives its significance from its association with the early twentieth century development and expansion of the New Post at Fort Sill between 1900 and the First World War. Additionally, the building is significant as an example of early twentieth century architecture built in the Mission style and in the development of industrial support facilities for military installations.

BUILDING 1815

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Date of erection: Building 1815 was constructed in November 28, 1911 and regularly upgraded through the 1920s.

2. Architect: Office of the Quartermaster General, Plan No. 2-912.

3. Original and present owner: U.S. Army.

4. Builder: Unknown.

5. Original drawings: Original drawings are on file at the Directorate of Public Works and at the archives at Fort Sill.

6. Alterations and additions: Building 1815 remains essentially intact although some of the equipment and fittings have been removed from the interior and the stack was demolished. A coal trestle was built in 1911 and a water cooling tower in 1918. While remnants of the trestle remain, the cooling tower has been demolished.

B. Historical Context:

See Historic Context attached herewith.

PART II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural Character: Building 1815 retains most of its original character although its original windows and doors have been covered with plywood and its tall stack has been demolished. Built in a variant of the Mission Revival style known as the Alamo style, the building has contoured parapeted gables, a red clay tile roof and segmentally-arched door and window openings. Windows and doors are of wood. Located adjacent to a railroad, a portion of the original reinforced concrete coal trestle remains immediately to the south of the structure.

2. Condition of fabric: Building 1815 is in fair condition although it has been abandoned and is scheduled for demolition.

B. Description of Exterior:

1. Over-all dimensions: Main building: 180' x 40', Wing: 66'- 6" x 80'.

2. Foundation: Reinforced concrete slab and beams.

3. Walls: Reinforced concrete.

4. Structural system: Steel trusses with some heavy timber framing.

5. Porches: None.

6. Chimney: The large brick stack to the west of the building has been demolished. Remnants of base remain.

7. Openings: Doors are wood panel doors with transoms set in openings cast into the reinforced concrete walls. Windows are wood sash and casement windows set in openings cast in the reinforced concrete walls.

8. Roof: The roof is gabled and terminates at the parapets formed by the extension of the exterior walls above the roof line. The roof is clad in red, French-styled, clay tiles. Eaves extend over the walls and have gutters attached. Gutters are half-round and downspouts are fluted.

C. Description of Interior:

1. Floor plan: The floor plan is a "T" - plan building. The central element of the "T" has a coal bin, a boiler room, and a work shop. The wings are a power plant and an ice plant. The coal bins and the boilers are located on a lower level while the work shop has a loft.

2. Stairways: Metal stairways with pipe rails lead from the power plant down to the boiler room and from the work shop up to the loft.

3. Flooring: The flooring throughout the building is exposed concrete that has been smoothed through use.

4. Wall and ceiling finishes: walls are of exposed concrete with exposed form marks. The ceiling is of painted wood decking above the steel structure and the wood structure above the loft. In the ice plant area, varnished, beaded wood wainscotting has been applied over the concrete wall surface. Freezer walls are sheathed with cork panels.

5. Openings: Interior doors are wood panel doors except for doors to ice storage rooms, which are covered in varnished, beaded boards applied vertically.

6. Decorative features and trim: None.

7. Hardware: Standard mortise locks and functional, industrial hardware are used throughout the building.

8. Mechanical equipment: The mechanical, lighting, and plumbing systems of the building were originally designed to produce power and manufacture ice. Over the years, the equipment has been updated, replaced, modified, and in some cases demolished. Original manifests provide a listing of the primary equipment of the building. That listing includes:

Power Plant:

4	Babcock Wilcox, vertical head, water tube boilers
3	Ridgeway, 4-valve, non-releasing engines
3	Ridgeway, A.C. generators
25	A.C. transformers (13 G.E., 8 Westinghouse, 1 Western Electric, and 1 Wagner)
2	Worthington duplex feed pumps
1	Harrison feed water heater
3	Thompson-Ryan, D.C. belted exciters
6	Auto and hand-starting motors (2 Wagner, 2 Century, 1 G.E., and 1 Westinghouse)
1	Rotary transformer for telephone battery storage

Ice Plant:

1	York, vertical, single-acting, 10 ton, double column ammonia compressor
2	York, charcoal, pressure filters
132	York, 200 lb, galvanized ice cans
1	York, flat, closed coil, reboilers
1	Blake, 66 gallon, inside, duplex brine pump
1	Blake, 20 gallon, outside, duplex water distribution pump

The ice tank has ribbed clay tile blocks laid in the floor of the ice pit.

D. Site:

1. General setting and orientation: Building 1815 is located at a major road intersection at Fort Sill and is adjacent to railroad tracks which run along the north side of the building. A creek runs east-west to the south of the structure. The land is nearly flat and slopes gently to the creek. To the east of the building, numerous concrete equipment mount pads remain although the equipment has been removed. Eleven reinforced concrete trestle supports and three remnants of trestle supports remain immediately to the south of the structure.

2. Historic landscape design: Building 1815's original setting was that of an industrial facility and lacked vegetative materials. The site was functionally designed and site features included railroad tracks, trestles, roads, power poles, overhead wires, and other items.

3. Outbuildings: None.

PART III. SOURCES OF INFORMATION

A. Original Architectural Drawings: Original architectural drawings are in the hanging files and on microfilm in the Directorate of Public Works, at Fort Sill. Copies are also in the collections of the Fort Sill archives. Original O.Q.M.C. drawings are listed as Plan No. 2-912.

B. Early Views: Building 1815 is shown on installation maps after about 1912. Early photographic views may exist in the collections of the Fort Sill archives.

C. Interviews: None.

D. Bibliography:

1911 War Department, *Q.M.C. Form No. 117,* Fort Sill Archives.
1930 War Department, *Q.M.C. Form No. 109,* Fort Sill Archives.

PART IV. PROJECT INFORMATION

See Abstract attached herewith.

HISTORIC CONTEXT FOR THE POWER AND ICE PLANT, BUILDING 1815, FORT SILL MILITARY RESERVATION, OKLAHOMA

by Kellie A. Krapf

INTRODUCTION

This report contains a historical background for the Power and Ice Plant, Building Number 1815, at Fort Sill Military Reservation. A short history of the power and ice industry is presented first. The development of combination plants in the U.S. and Oklahoma is outlined second, followed by a discussion of the military use of power and ice plants, with emphasis on the plant at Fort Sill Military Reservation.

HISTORY OF THE POWER INDUSTRY IN THE U.S.

During the late 1800s and early 1900s, there were two types of power generating plants in the U.S., isolated power plants and central stations. The earliest power plants were isolated generating plants. Isolated power plants provided electrical current to factories, mills, department stores, hotels, or other commercial enterprises that needed large quantities of electricity. This type of power plant was attached to a specific facility needing power. According to Hutchinson (1932), editor of the journal Power, isolated power stations were constructed "because of the lack of unity and market demand," and the slow progress of the electrical industry. In the census of 1902 (Department of Commerce 1910:14), it was estimated that there were over 50,000 isolated plants, and by 1907, an estimated 65,000 isolated plants existed in the U.S.

The development of central station power began in the fall of 1878 with the organization of Thomas Edison's electric lighting project at Menlo Park, New Jersey. The impetus for the expansion of the electrical industry was Edison's discovery of the incandescent lamp and the filament lamp with a circuit interpreting device. After this discovery, he visualized the transference of power over a large area from a single point. To create a central station, Edison had to develop a high resistance filament that would withstand the large volume of electrical currents. In his research, Edison was always aware that to build an electrical station, the electrical current had to be less expensive than gas or coal. After developing a higher-resistancy filament and a generator with low resistance, Edison turned his attention to creating small scale models of an electrical central station on Pearl street in New York that would light one city block.

Edison's goal was to supply power by way of a central station that would distribute electric light to the public, not for private means, as was true of isolated power plants. The plan was to use steam or gas

boilers, engines, generators, and auxiliary equipment in a separate area to provide power to nearby houses and businesses within a one square-mile area around 257 Pearl Street, in the financial district of New York

After the successful demonstration of Edison's first central station, there was rapid growth in the power industry. The first census of central stations was completed in 1902 and recorded 3,620 establishments; by 1907 the number had grown to 4,714; in 1912 there were 5,221; and in 1917 there were 6,542 establishments (Table 1). Between the years 1902 and 1912, the number of central stations increased at a rate of 44.2 percent. The highest rate of increase was between 1902 and 1907 with 30.2 percent, and the lowest rate of increase was 10.8 percent between 1907 and 1912 (Department of Commerce 1910:16 and 1915:18).

HISTORY OF THE ICE AND REFRIGERATION INDUSTRIES IN THE U.S.

The ice and refrigeration industries in the U.S. were initially intertwined, simply because the earliest form of refrigeration was ice. The ice was harvested and transported from northern lakes, streams, rivers, and ponds to cities in the North and the South. Progress in the ice and refrigeration industries created two separate branches in these industries, natural and artificial ice refrigeration, divided along regional lines (Authenrieth 1927:4). In the northern portion of the U.S., natural ice was harvested and used as a refrigerant in conjunction with icehouses where food products were stored. In the southern portion of the U.S., artificial ice was developed as an inexpensive form of refrigeration, because natural ice was expensive and in short supply in the South. The marketing of natural ice in the U.S. began in the early nineteenth century, while the manufacture of artificial ice was not attempted in the South until about 1863 (Anderson 1953:7; Baker 1929).

The distribution of natural ice throughout the U.S. was difficult and expensive, due to the cost of harvesting and shipping to the larger cities. The use of ice was not popular until 1830, when the population had grown to such an extent that it was lucrative for the ice to be harvested and sold to the public. At this time, the American diet began to change. Before the 1830s, foods that required cold storage were not part of the daily diet of American settlers. The diet was based on breads and cured meats, for they were not as difficult to keep fresh as the later staples of dairy products, fresh meat, and produce. Additionally, refrigeration was not as important for the simple reason that most families ate what was produced on their own farms; therefore, refrigeration was not needed for the transportation of food stuffs.

Between 1830 and 1910, there was an increased demand for fresh fruits and meats, milk, and other dairy products (Anderson 1953:14). The economic status of urban areas also improved, providing inhabitants the means to purchase more expensive fresh foods. Perhaps the most important reason for the increased use of ice was the increased growth and expansion of the urban areas (Anderson, 1953:8). As the number of city-dwellers increased, it was more difficult to obtain fresh food because they were so removed from the places where it was produced. A reliable means of refrigeration was needed to preserve fresh food while being shipped to long distant markets.

In the southern states, only a few cities could obtain ice because of the difficulties in transportation; therefore, ice was difficult and expensive for inland cities and towns to purchase. Thus, few inhabitants in the South could afford this northern luxury (Baker 1929). The shortcomings of using natural ice as a refrigerant were evident in the southern states. Given the high cost and uncertainty of the shipments to southern ports, and lacking an inexpensive means of refrigeration, the South was unable to develop the same agricultural industries the North enjoyed, with its cheap and readily-available supply of natural ice. The South was unable to attract industries such as meat packing, dairying, and brewing; more importantly, the southern states were not able to expand their agricultural markets with the use of ice refrigeration to

Table 1
Number of Central Stations in the U.S. for
Years 1902, 1907, 1912, and 1917

State	1902	1907	1912	1917
Alabama	25	55	69	82
Arizona	13	15	16	29
Arkansas	42	63	74	69
California	115	129	112	98
Colorado	48	56	73	69
Connecticut	38	41	44	43
Delaware	10	14	18	22
Florida	26	37	50	82
Georgia	43	93	126	176
Idaho	19	42	38	46
Illinois	346	383	269	303
Indiana	180	200	201	237
Iowa	169	192	223	325
Kansas	61	111	176	302
Kentucky	58	83	89	125
Louisiana	25	42	50	85
Maine	52	81	79	93
Maryland	32	36	38	41
Massachusetts	114	120	117	120
Michigan	201	234	235	241
Minnesota	138	171	195	255
Mississippi	43	68	82	97
Montana	27	33	29	60
Nebraska	54	98	174	297
Nevada	5	9	8	14
New Hampshire	51	56	59	59
New Jersey	64	64	64	63
New Mexico	11	15	21	29
New York	256	314	321	332
North Carolina	38	71	94	159
North Dakota	21	29	42	127
Ohio	233	272	304	335
Oklahoma	20	72	130	201
Oregon	39	61	66	68
Pennsylvania	279	327	284	284
Rhode Island	7	7	8	9
South Carolina	24	40	61	82
South Dakota	28	37	77	131
Tennessee	54	78	90	106
Texas	137	218	253	254
Utah	16	31	45	47
Vermont	52	60	61	59
Virginia	37	51	67	94

Table 1 (cont'd)

State	1902	1907	1912	1917
Washington	40	71	70	88
West Virginia	41	48	58	72
Wisconsin	152	206	251	269
Wyoming	13	18	20	43
Alaska	4	9	n/a	n/a
Hawaii and Puerto Rico	n/a	6	n/a	n/a
Totals	3,624	4,714	5,221	6,542

n/a - data not available

ship fruits and vegetables to long-distance markets (Anderson 1953:68). To meet their vast agricultural and industrial potential, the southern states needed a dependable and inexpensive source of refrigeration and ice (Anderson 1953:70, 73).

After the Civil War, the first reliable mechanical refrigerators and artificial ice plants were being used for commercial purposes in the South. After the 1860s, the coastal ice trade to the South began to decline because of increasing competition from the manufactured ice industry (Anderson 1953:39). By 1869, four artificial ice-making plants were recorded in the southern states; one plant each in Tennessee and Texas, and two plants in Louisiana (Anderson 1953:86). The use of artificial ice plants spread rapidly throughout the U.S., so that by 1879 the number of plants increased to 29 in the southern states. Texas led with 12, followed by Georgia with 8, Louisiana with 4, Alabama with 3, and Kentucky and Arkansas with one plant apiece (Anderson 1953:86).

After 1879, many of the natural ice companies in the north began to fail, due to the increased reliance on artificial ice. By the early 1880s, the market for natural ice in the South was confined to the port cities (Anderson 1953:39). The failure of the natural ice trade caused a rapid increase in the number of artificial ice plants constructed. There were 222 plants in 1889, 775 plants in 1899, 1,320 plants in 1904, and 2,004 in 1909 (Department of Commerce 1913:437). For a state by state listing of establishments for these years, see Table 2. From 1899 to 1909, the present state of Oklahoma had the most rapid increase in the number of manufactured ice establishments (see Table 2). In 1899, Oklahoma had 9 artificial ice establishments and by 1904, it had 44 establishments. By 1907, manufacturing of ice was the sixth largest industry in Oklahoma, with 77 plants, and was ranked eighth in the total number of wage earners, with 614 persons (Department of Commerce 1913:1,012). According to the 1914 Census of Manufacturers for Oklahoma, the rank of the manufactured ice industry fell to seventh, with 97 ice-making facilities (Department of Commerce 1919:1,228). This slight fall in rank was due to the growth of foundry and machine shops in Oklahoma.

Combination Plants in the U. S.

In the early twentieth century, there was a trend for central power stations to incorporate auxiliary facilities, such as an ice factory, to fill up the valleys in load curves of the stations. "Peaks" and "valleys" refer to the high points and low points in the total load of electrical energy carried by a plant in a given period of time. Several benefits occurred from the incorporation of auxiliary systems such as manufactured

Table 2
Number of Artificial Ice Plants in the U.S. for Years 1899, 1904, 1909, 1914

State	1899	1904	1909	1914
Alabama	21	39	45	55
Arizona	9	13	23	27
Arkansas	15	38	49	65
California	20	54	77	95
Colorado	6	16	30	32
Connecticut	5	7	7	5
Delaware	7	10	15	18
District of Columbia	4	6	7	n/a
Florida	33	47	70	92
Georgia	32	48	61	74
Idaho	n/a	n/a	4	10
Illinois	29	43	83	128
Indiana	47	66	85	106
Iowa	3	4	18	34
Kansas	19	44	86	101
Kentucky	31	48	78	93
Louisiana	34	62	69	76
Maryland	18	27	42	62
Massachusetts	n/a	n/a	7	6
Michigan	n/a	n/a	5	11
Mississippi	21	37	51	58
Missouri	31	53	92	117
Nebraska	n/a	n/a	1	18
Nevada	n/a	n/a	3	3
New Jersey	26	39	59	71
New Mexico	4	7	10	15
New York	41	58	89	111
North Carolina	23	32	45	61
Ohio	42	69	97	132
Oklahoma	9	44	77	97
Oregon	9	20	25	27
Pennsylvania	73	109	170	189
Rhode Island	n/a	3	5	n/a
South Carolina	13	18	32	36
Tennessee	27	37	57	70
Texas	77	125	182	255
Utah	n/a	n/a	4	10
Virginia	30	48	74	87
Washington	4	12	25	32
West Virginia	8	30	35	47
other states	4	7	4	17
Total United States	775	1,320	2,004	2,543

n/a - data not available

ice plants. Ice plants could use the excess power generated from the lighting and heating plants, which is a cost-effective way of using existing surplus energy. The use of manufactured ice as an auxiliary system enabled central stations to run 24 hours a day, thus, using the generating equipment in a more efficient manner and at the same time reducing the cost of the power supply (*Electrical World* 1911a and 1911c).

Another reason for incorporating ice plants is that the peak and low loads of an electric plant are at the opposite times of the year from those of an ice plant. The low load period for central stations is in the summer months from June to September, when power is not used for heating and electrical lights. The peak time for ice making is in the summer months. By incorporating an ice plant for use in the summer months, the central station can run all year round at the same peak load. In addition, ice as an auxiliary system provided central stations with increased profits during the summer months, when artificial ice was sold for public consumption. These additional profits came at a time of the year when the central stations ran at a loss because customers were not using as much electricity (*Electrical World* 1911a and 1911c). Also, an ice-making factory can help boost the power of generating equipment by providing it with additional power. If an auxiliary system was not present, central stations required costly live steam to boost the power of electrical plants (Lee 1907). Additionally, the presence of a power plant alleviated the expense of purchasing steam condensing equipment to produce distilled water. When the heating and lighting plants were run in the winter, water condensed on the main pipes and ran off into ice cans; later, the water was filtered and then frozen to produce blocks of ice (*Electrical World* 1911a and Lee 1907).

The benefits of combination plants were not realized until after many of the separate ice plants were constructed. It would have been costly, however, to convert an ice plant into a combination plant, and in many areas there were already existing power plants. Most of the combination plants built during the early twentieth century were constructed in the developed areas in the west, such as Oklahoma and Kansas. The reason for the construction of the plants was that the technology was developed as the areas were being settled, and there was a greater need for combination power and ice plants because of the arid climates.

The editor of *Electrical World* suggested that combination plants were constructed in the newly developed states due to "progressiveness and foresight, reflecting the general tendency in small cities of newly developed regions to install only the most modern and productive equipment" (*Electrical World* 1911a).

Census data on the distribution of combination plants indicates that the number of both commercial and municipal electric plants increased between 1907 and 1917, but the peak period for combination plant construction occurred during the ten year period from 1902-1912. The largest increase occurred between 1907 and 1912. In the ten years from 1902 to 1912, the number of combination plants increased 65.4 percent, while the number of electric plants increased only 29.6 percent. This higher increase in combination plants indicates the increased importance of these plants (Department of Commerce 1915:25).

In 1911, *Electrical World* conducted a survey of combination plants to document the number of central stations that used ice manufacturing as an auxiliary system. Of the stations that answered the survey, 256 had ice-making facilities in conjunction with central stations. The distribution of combination plants indicates that a higher proportion of them were located in smaller cities and towns in the south, but with increasing numbers in the north central and central areas of the U.S. (Table 3). Two hundred and seven plants were located in towns and cities with populations less than 5,000 and cities of 5,000 or more had 49 combination plants (*Electrical World* 1911b). This may be due to the fact that most of the combination plants were owned by municipalities, which owned their utilities and incorporated ice as a utility. The absence of combination plants in larger cities is probably because of the competitive nature of the power and ice industries. The large populations in cities allowed ice plants to stand alone because there were enough residents purchasing ice to keep them in business. Power plants did not need auxiliary systems because the populations were large enough that plants were able to run 24 hours a day with an even electrial load.

Table 3
Number of Combination Electric and Ice Plants in the U.S. in 1911

State	Number of Plants
Arkansas	10
California	4
Colorado	4
Connecticut	2
Florida	17
Georgia	4
Hawaii	1
Illinois	16
Indiana	4
Iowa	4
Kansas	13
Kentucky	18
Louisiana	7
Michigan	1
Mississippi	5
Missouri	15
Nebraska	4
New Jersey	2
New Mexico	3
New York	1
North Carolina	5
Nevada	1
Oklahoma	22
Ohio	1
Oregon	1
Pennsylvania	1
South Carolina	3
Tennessee	8
Texas	83
Virginia	8
Washington	1
West Virginia	5
Total	252

In 1911, the largest number of combination plants were located in the southern states. Especially in rapidly developing areas, such as Texas, Oklahoma, and other western states, the number of combination plants was increasing rapidly. The state of Texas had the largest number of combination plants, with 83, and Oklahoma had the second largest number, with 22. Texas had the highest number because of its large population and area and its many small towns with populations under 5,000. The growth in Oklahoma and other western states was due in part to the arid climate, rapid population growth, and the progressive character of the electrical industry in those regions.

By the early 1920s, the utility companies were rapidly growing and began purchasing municipal power stations. When utility companies purchased electric companies, many found themselves in the ice business because many of the electrical plants had auxiliary ice plants. One such utility company was the Middle West Utilities Company, located in Chicago, Illinois. Most of the combination plants purchased by Middle West Utilities were located in Illinois, Kentucky, Missouri, Virginia, Arkansas, Oklahoma, and Texas. This company opened the first combination electric and ice plant in Lawton, Oklahoma in the early 1920s. At the same time, the Middle West Utility Company purchased the municipally-owned electric and ice plants in Atoka, Okmulgee, and Vinita, Oklahoma. By the early 1920s, the Middle West Utilities Company had purchased more than 167 combination plants in which ice was the auxiliary system (Figure 1). The Middle West Utilities Company owned 22 combination power and ice plants in Oklahoma by December 1926 (Authenrieth 1927:7; see Figure 1). The largest number of combination plants owned by Middle West Utilities was in Texas.

Military Combination Power and Ice Plants

In the 1880s, U.S. military installations had a need for both power and ice facilities. The earliest forms of these corresponded with the types the rest of the nation was using. At Camp Custer, located near Eagle Lake in Michigan, for example, natural ice was harvested and stored in large icehouses (Graf 1925). Later, as the need for power and ice increased, military installations purchased ice and power from central stations that were located in nearby towns. At Fort Knox in Kentucky, the installation relied on the Louisville Gas and Electric Company for electricity (Pamela Schenian, personal communication 1994). In 1919, transmission lines were constructed that ran from a central station in Louisville, Kentucky, to several small substations that were constructed on the installation. There is no mention, however, of an ice plant in the construction records at Fort Knox. In this case the installation purchased ice from a local commercial ice plant located in Louisville. As the cost of purchasing electrical power and ice from local plants became too expensive, the military installations constructed their own separate power and ice plants.

By 1906, the U.S. government had become so dissatisfied with the exorbitant prices of electricity and ice, it began constructing federally-owned and operated power and ice plants to supply government installations (Wentworth 1913: 1). The use of a combination power and ice plant at the Fort Sill Military Reservation appears to be unique among all American military installations. The progressive nature of the technology used in Oklahoma during the 1910s contributed to the creation of a combination plant at the Fort Sill Military Reservation. Prior to the construction of the power and ice plant in 1911, the Fort Sill Military Reservation used isolated power plants that were attached to buildings such as the hospital and the administrative center. Before the 1880s, ice was harvested in the winter from nearby streams and put in an ice house for storage. In the early 1890s, when natural ice was not available for harvesting due to mild winters, an ice machine was attached to the side of the now-completed ice house. As the ice was produced, it was stored in several rock ice houses located throughout the installation (Nye 1988:229, 288).

In 1911, a combination power and ice plant was constructed at Fort Sill Military Reservation for two reasons: (1) the demand for ice exceeded the daily capacity of the ice machine, and (2) the nearest town, Lawton, did not have a commercial supply of ice. Therefore, the installation had no means of purchasing ice for purposes of cold storage, refrigeration, or general consumption. Building No. 1815 was constructed in a variant of the Mission Revival style known as the Alamo style, with contoured parapeted roof gables, a French style red clay tiled roof, and segmentally-arched door and window openings. The doors are wood paneled with transoms. The windows are wood sash and casement windows. The walls and floor are reinforced concrete slab and beams. The building has a "T" plan, the main portion measuring 180 x 40 feet and the wing is 66 x 80 feet. The central element of the "T" is a cod bin, a boiler room, and a work shop. The wings of the building are a power plant and an ice plant. The ice plant consisted of seven cold storage rooms and an ice tank (Figure 2).

Figure 1. Combination power and ice plants owned by the Middle West Utilities Company in December, 1926.

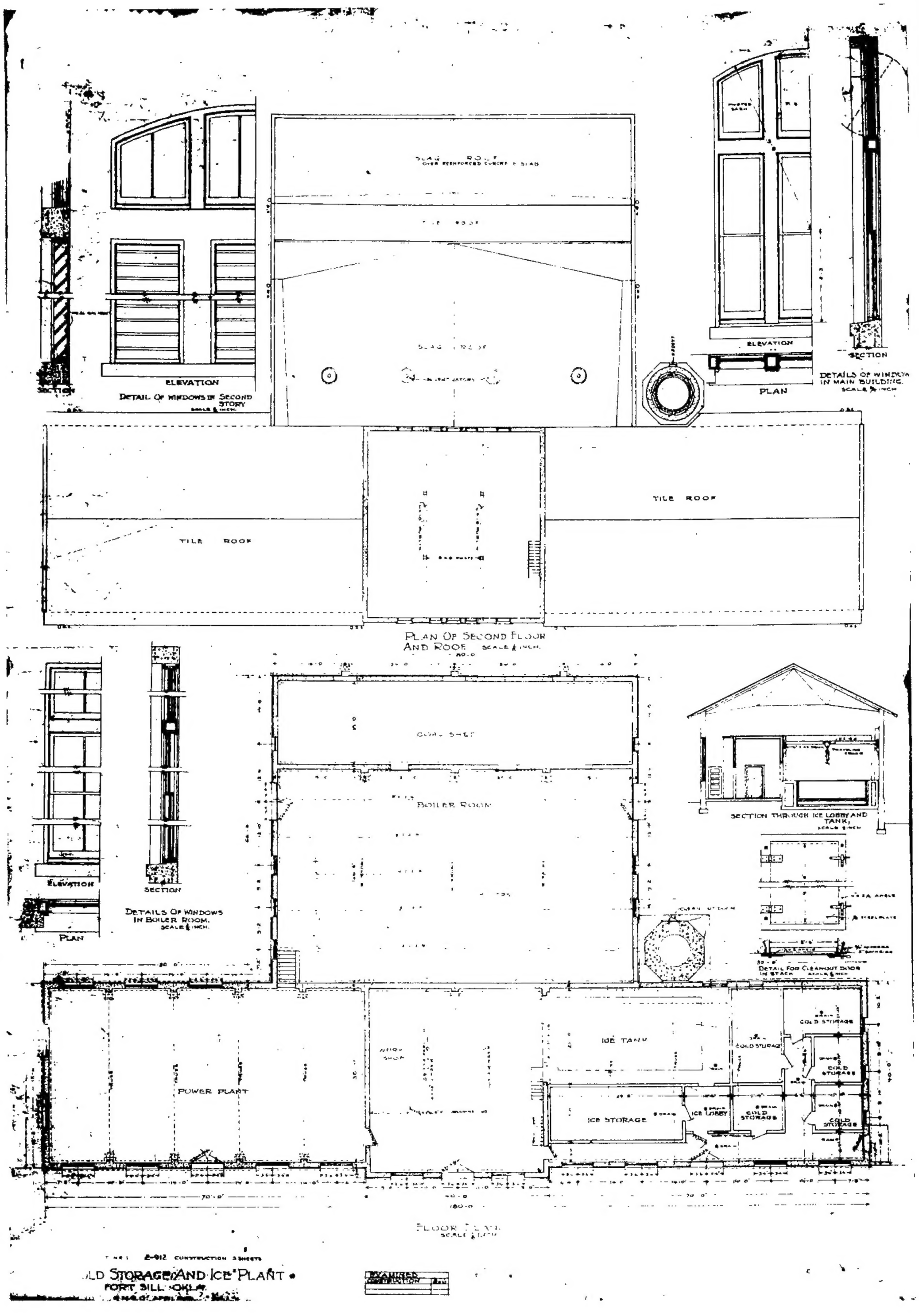

Figure 2. Floor plan of the power and ice plant at Fort Sill Military Reservation.

The Fort Sill Military Reservation combination plant was constructed to run three departments: lighting, heating, and refrigeration. The power plant consisted of the lighting and heating departments. The lighting plant was used to illuminate over 4500 interior and street lights located on the installation (Montgomery 1916). The heating plant is a hot water system that automatically heated the stored water when the outside temperature was below 45 degrees (Montgomery 1916). Water for the heating system was pumped from three nearby wells known as the Ambrosia springs. The water was pumped into a concrete 500,000 gallon reservoir (Montgomery 1916).

The refrigeration plant was both an ice-making and cold storage facility. The capacity of the ice-making equipment was 10 tons per day. There were 7 cold storage rooms that used 4 tons of ice daily for refrigeration. The other six tons were used for ice boxes and general consumption throughout the installation. The cold storage rooms were used to refrigerate perishable foods that were used for installation consumption. The refrigeration plant used can freezing and the tank could hold 130 cans each weighing 200 pounds. A brine and calcium chloride system was used to freeze water for ice making. Ice was made from condensed water that collected from running the heating and lighting plant. To rid this water of impurities the water was either boiled or filtered, producing clear ice (Montgomery 1916).

During the buildup for World War I, there was a great need for ice and cold storage at military installations for the transportation of food supplies from the western states to the eastern seaports (Ice and Refrigeration 1917:50). Ample refrigeration was needed to ensure that food would still be edible by the time it arrived at troop locations overseas. In the 1910s, the government began constructing ice plants and cold storage rooms on many of the military installations where local facilities did not exist, so that the incoming foods at the installation would be in excellent condition for daily consumption. These previously constructed cold storage areas and ice-making facilities were then used during World War I as shipping points to other military installations. The U.S. government used many of the existing facilities such as the ice and refrigeration plant at the Fort Sill Military Reservation, where artificial ice could be easily transferred into railroad cars and shipped. New ice and cold storage facilities were constructed in 1917 at Annapolis Junction, Maryland; Ayer, Massachusetts; Wrightstown, New Jersey; Fort Riley, Kansas; Chillicothe, Ohio; Rockford, Illinois; and Battle Creek, Michigan (Ice and Refrigeration 1917:50).

Prior to World War II, a separate refrigerated cold storage warehouse was constructed on the north side of the railroad, a few miles to the west of Building No. 1815. At this time, the cold storage rooms in the power and ice plant were used as storage rooms for the power plant. During World War II, when cold storage was in short supply, the rooms in the power and ice plant were once again used to store perishable foods. In the early 1950s with the development of more modern electrical facilities and modern refrigeration, the power and ice plant became obsolete. In the early 1960s, after the construction of the modern electrical station, the power and ice plant was then designated as a storage warehouse. Presently, the power and ice plant is vacant and has been scheduled for demolition.

As the building became gradually abandoned, several alterations occurred. In 1918, a cooling tower was added to the building, but has since been demolished. Only remnants remain of a coal trestle attached to the building during the original construction. A portion of the trestle is located immediately south of the building. Through the years, the mechanical equipment of the building has been updated, replaced, remodeled, and some has been demolished. Although there have been some modifications to the structure, it remains essentially intact.

As one of 22 power and ice plants in the state of Oklahoma in 1911, the power and ice plant at the Fort Sill Military Reservation, Building No. 1815, reflects the progressive climate of the industry in the western United States during the early twentieth century. More significantly, the presence of a combination plant at the Fort Sill Military Reservation appears to be unique as a military support structure. Its role in providing refrigeration for shipment of critical food supplies during World War I makes the combination plant particularly important in recent military history.

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